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HANDBOOK

FOR THE

25-PR. RIFLED M.L. GUN OF 18 CWT.

1880.



LONDON:

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AND SOLD BY*

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1880.

Price One Shilling.

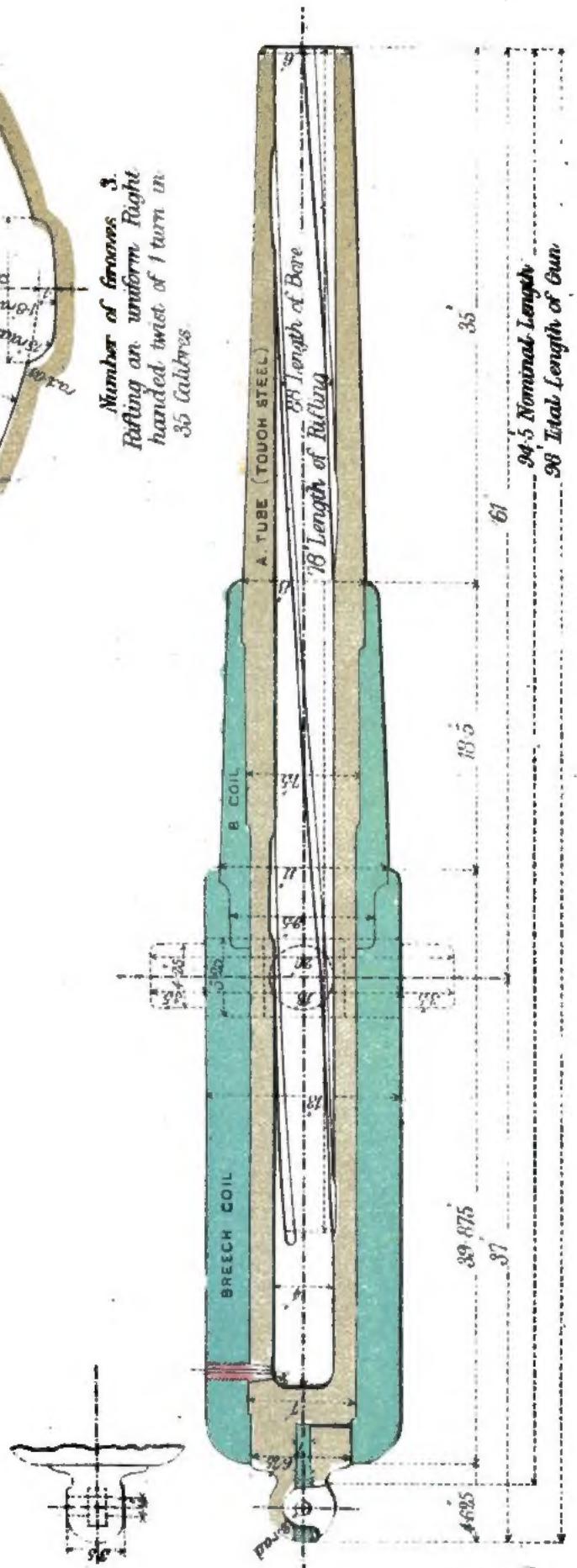
(Wt. 7845 1880)

ORDNANCE WROUGHT IRON RIFLED M. L. 25 PR 18 CWT. MARK I.

SECTION OF GROOVE.
Full size.



Number of grooves 3.
Rifling an. uniform Right
handed. twist of 1 turn in
35 calibres



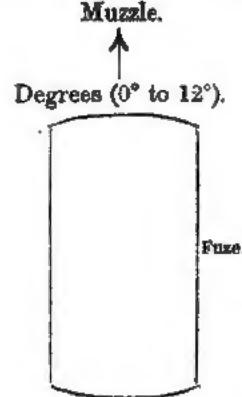
MEMO.

This Handbook is correct up to July 1st, 1880. For alterations, orders issued since that date must be consulted, and the text amended.

25-pr. rifled muzzle-loading Gun of 18 cwt.

DESCRIPTION (FRONTISPICE).		
Length,	{ nominal	7 feet 10 1/2 inches.
	{ total	8 feet 2 inches.
	{ of bore	7 feet 4 inches.
	{ of rifling	6 feet 6 inches.
Preponderance (average)		7 1/2 lb.
Calibre		4 inches.
Weight (average)		17 cwt. 3 qrs. 17 lb.
Twist of rifling, uniform		1 in 35 calibre.
Vent of hardened copper		1 inch from end of bore.

The gun is side-sighted only, viz.: 3 tangent scales, set at an angle of 53' to the left to correct drift. The scale is four-sided, and has a gun metal sliding leaf graduated to 30' for deflection in order to allow for wind or other irregularity, and a slow motion elevating nut under the cross-head also, graduated round its circumference from 1 to 10 minutes, for finer adjustment in elevating. It is marked as follows:



Yards, 4,000.

2 trunnion sights. These sights are of the ordinary service drop-sight pattern, and are identical with those of the 40-pr. rifled M.L. gun.

A hydro-clinometer is supplied for elevations above 12°.

PROJECTILES.—Plate I.			Weight.
Shells,	{ Common	{ empty	23 3 1/2
		{ filled, with 1 1/2 lb. bursting charge	24 1 1/2
	{ Shrapnel	{ filled, with 158 mixed metal bullets,	25 3
		{ lets, 45 at 34 per lb., and 113 at 20 per lb., and 3 oz. bursting charge	
Shot, case		{ filled with 245 mixed metal bullets, at 16 1/2 per lb., clay and sand	24 4

CHARGE.

Service, silk cloth* 4 lb. R.L.G.† powder.

FUZES.—Plate III.

Percussion, R.L. Mark II, for use with common shell intended to burst on impact or on graze, and for shrapnel shell intended to burst on graze.

Wood, † time,	{ 5 seconds M.L. for use with shrapnel shell when time of flight is less than 5 seconds, and on an emergency with common shell.
	{ 9 seconds M.L., for use with common shell and with shrapnel shell when time of flight is more than 5 and less than 9 seconds.
	{ 20 seconds M.L., for use with common shell for times of flight over 9 seconds.

* Issued in paper covers. For saluting, service charges are to be used.

† R.L.G. powder will ultimately supersede B.L.G.

† The 5 and 9 seconds fuses will be eventually replaced by the 15 seconds M.L. fuse, and the 20 seconds by the 30 seconds fuse, when the existing store becomes used up.

CARRIAGE AND LIMBER, MARK I.

The carriage is formed of two bracket sides, connected by transoms, bolts and a trail piece; an axletree bed, with axletree, and field wheels.

Each bracket side is constructed of plate iron riveted to the inner side of an angle iron frame.

The eye of trail piece is steeled to prevent wear.

The axletree bed is of wrought iron, constituting with the axletree a beam of box-girder section. It is connected to the brackets by stays.

The wheels are the 2nd class field with metal navea, and tire 3 inches wide.

The elevating gear is of the worm wheel pattern, and is placed on the right side only; it consists of a "worm shaft" or "endless screw" with hand wheel, held in bearings on the outside of the carriage bracket, gearing into the teeth of a worm wheel, fitted with a friction clutch, giving motion to a wrought iron pinion, gearing into the teeth of the arc attached to the gun; the arc with its pinion is kept in gear by means of a metal friction roller, fixed on the inside of the bracket of the carriage. The wheel and screw are covered by a metal guard, which forms the bearing for the wheel spindle; it is made in two parts, and hinged together so as to give ready access to the wheel, &c.

A stool bed of wood strengthened by an iron plate along each side, large coin, hand coin, and scotch are fitted to and issued with the carriage, for use in laying the gun in case of any damage to the elevating gear.

The carriage is fitted for the attachment of hanging scales, and the pocket for priming irons is strapped on the rear transom.

The axletree boxes are not fitted with guard irons or steps, and carry each 2 rounds of case and small stores.

The limber, which is the Mark II field limber, is formed on the same plan as the wood limber, but has the futchels and splinter bar of iron.

The axletree bed is of wrought iron instead of wood, and with the axletree constitutes a beam of box-girder section.

The limber hook is made to stand out from the bed and so obviates the necessity of a block between them; it is steeled to prevent wear, and has a steel key.

The shafts are "near" and "off," the latter known as the Brandling pattern, and the limber is fitted for single, double, treble, and bullock draught.

The limber boxes are "near," "off," and "centre;" the near and off carry each 9 projectiles, and as many cartridges in a canvas cartouch; each projectile is fitted with a lifting strap.

The foot board is fitted with a box to contain the hanging scales.

		ft. ins.
Height, centre of gun	-	3 10
carriage, {	with wheels	10 6
	without wheels	9 3
Length of axletree	-	6 3 $\frac{1}{2}$
	carriage and limber {	19 9 $\frac{1}{2}$
	without gun	24 2 $\frac{1}{2}$
Minimum space through which carriage can turn	-	33 9
Angle of trail	-	23°
Elevation, maximum	-	45°
Depression, maximum	-	5°
Wheels, {	track	5 2
	diameter	5 0
	carriage, empty, with wheels, drag } shoe, and arc, elevating } limber, empty, with boxes, shafts, and } wheels } wheels } arc, elevating }	cwt. qrs. lb.
Weight of		15 0 0
		11 1 0
		4 2 4
		0 0 17

OVERBANK CARRIAGE.

When this gun is used as a siege gun it is mounted on an overbank carriage constructed to fire over a 5 feet 8 inch parapet.

The "overbank" is the service pattern carriage fitted with a top of wrought

iron, a special elevating gear, arranged to depress 30° for loading, and a step for laying the gun.

The top is formed of two bracket sides connected by cross bolts and secured to the carriage at the front by a strap bolt on each side of each bracket and at the rear by clips and bolts. The elevating arrangement consists of a worm shaft and wheel, working an elevating pinion and arc by means of a friction cone. This gear is fixed at the front of the carriage between the brackets and is driven by a handwheel, the elevating arc being secured at each end to the underside of the gun.

The following is the way to remove the top:—

Detach the elevating arc from the gun and dismount the latter, turn the handwheel of the elevating gear until the teeth of the arc are clear of the pinion, when the arc can be removed, take off the nuts and clip plates of the strap bolts and remove the rear clips and bolts, which will allow the top to be lifted off.

	cwt.	qr.	lb.
Approximate weight of top	7	0	0
Height to centre of gun at trunnions		6	feet.
Elevation			35° .

A breech loop and an iron roller are supplied with these tops; they are required for shifting the gun from travelling to firing trunnion holes. See page 15.

AMMUNITION WAGON.

The body of the wagon (which is the same as for 9-pr. and 16-pr., Mark II., or 40-pr.), consists of a perch of iron, with steeled eye and strengthening plates, two sides of angle iron, connected together by iron platea, over which the boards are secured, namely, two footboards and three platform boards.

The axletree bed is of wrought iron, and with the axletree constitutes a beam of box-girder section, the wheels are of the 2nd class, with metal naves and tire 3 inches wide.

The wagon is fitted with an iron bracket and arm for carrying a spare wheel, and has also fittings for carrying a drag shoe and stores.

The ammunition boxes (four) stand between the platform boards secured by iron nibs and straps; two are the same as the near gun limber box, and two the same as the off except leather fittings. Beneath the wagon are two under boxes.

The limber is similar to the gun limber, but does not carry a box for hanging scales.

	ft.	ins.
Length of wagon and limber	20	$7\frac{1}{2}$
Minimum space through which wagon can turn	29	$6\frac{1}{2}$
Weight of wagon and limber, empty	25	0 8

AMMUNITION WAGON WITH MARK I. WAGON AND LIMBER BODIES.

The wagon body differs mainly from the above in having the perch formed of girder iron in one piece with malleable cast-iron strengthening plates, in the axletree bed of wood and the block with arm for spare wheel being of wood strengthened with iron.

The limber body also differs in the axletree bed, being of wood and in the form of the limber hook, which is made to stand out from the bed by means of a block.

The wheels also differ in having the tire $2\frac{1}{2}$ inches wide.

	ft.	ins.
Length of wagon and limber	20	$5\frac{1}{2}$
Minimum of space through which wagon can turn	29	$8\frac{1}{2}$
Weight of wagon and limber, empty	25	1 16

25-PR. RIFLED M.L. EQUIPMENT, WAR ESTABLISHMENT.

LIMBER MARK I.

On Footboard.

1 lifting jack.
1 pair drag ropes, heavy.
1 hanging scale box, with hanging scales, chalk line, and reel.

Under Footboard.

1 felling axe.
1 drag washer, spare.

1 half-round tin grease box, 3 lb., under.

1 swingletree.
1 bill hook, under.

Off Box.

1 vent server.

NEAR BOX.

8 shrapnel shells.

On top of lid of Box.
1 blanket.
1 cover, waterproof.
1 corn sack.

1 shovel.

3 shrapnel shells.	9 filled cartridges in cartouch.	3 common shells.
		1 camp kettle, under.

CENTRE BOX.

1 oil can.

16 perch fuzes.

15 9-sec. fuzes.
5 5-sec. fuzes.
5 20-sec. fuzes.
5 5-sec. fuzes.
2 sponge cloths.

25 friction tubes.

1 pickaxe, under.

5 shrapnel shells.	9 filled cartridges in cartouch.	3 common shells.
		2 leather buckets, under.

On top of lid of Box.
1 blanket.
1 cover, waterproof.
1 corn sack.

1 spike.

On inside of Lid.
1 spring spike.
1 pair of scissars.
1 screw driver, large.
1 portfire clipper.
2 portfires.
1 tangent scale, spare.
1 drift wood.

GUN CARRIAGE

MARK I.

On top of Box.
1 blanket.
1 cover, waterproof.

NEAR AXLETREE BOX.

1 tin box, with cartridge.	2 spikes.
1 case shot.	1 case shot.
1 sponge cloth. 2 lanyards.	1 tin box with cartridge.

1 wrench, fixing, elevating rack.
1 case with tube
2 sponges with cups, under.
1 traversing handspike, under.
1 traversing handspike, under.
1 MacMahon spawner.
1 scatch.
1 pair of pliers.
1 case with fuse
1 pocket and a hook.
1 bore complete.
1 pair of pliers.
1 case shot.
1 case shot.
1 case shot.
1 wadhook worm, under.
1 tampon, with lanyard.
Weight about 50 cwt. 2 qrs. 0 lb.

OFF AXLETREE BOX.

1 couple 1 vent server.	1 tin box, with cartridge.
1 tin box with cartridge.	1 case shot.
	1 case shot.

On top of Box.
1 blanket.
1 cover, waterproof.

* Per division. † With No. I gun only.

Note.—Each shell is supplied with a lifting strap.

Note.— $\frac{1}{2}$ lb. of oakum is supplied to each sub-division; a little may be used with advantage to prevent movement of cylinders in centre boxes, and of case shot in axletree boxes. The remainder is carried in off-box, gun limber.

25-PR. RIFLED M.L. EQUIPMENT, WAR ESTABLISHMENT.

LIMBER MARKS I. or II.

On Footboard.

1 picket rope.
1 pair drag ropes, heavy.

Under Footboard.

1 felling axe.
1 drag washer, spare.

1 swing-tree.
1 bill hook, under.

Center Box.

Off Box.

1 half-round tin grease box.
3 lb. under.

Near Box.

1 vent server.

3 shrapnel shells.
9 filled cartridges in cartouch.
3 common shells.
1 camp kettle, under.
On inside of Lid.

On top of lid of Box.
1 blanket.
1 cover, wa-
terproof.
1 corn sack.

1 shovel.
1 hook, porer, with cylinder
and 6 bits.
1 porting stick.
1 key plug, G.S.

1 oil can.
16 perc fuzes
in box.
109-sec. fuzes.
105-sec. fuzes.
1 sponge cloth.

6 20-sec. fuzes.
50 friction
tubes.
1 sponge cloth.

25 friction
tubes.
2 lanyards.

1 picket, under.

3 shrapnel shells.

9 filled cartridges in cartouch.

3 common shells.

2 leather buckets, under.

On inside of Lid.
1 drift.
1 portfire clipper.
1 screw driver, large.

On top of lid of Box.
1 blanket.
1 cover, wa-
terproof.
1 corn sack.

WAGON BODY MARKS I. or II.

1 spare wheel.

On inside of Lid.
Nil.On inside of Lid.
Nil.

1 water brush, under.

On top of lid of Box.
2 blankets.
1 cover, wa-
terproof.

3 shrapnel shells.
9 filled cartridges in cartouch.
3 common shells.
1 camp kettle, under.
On inside of Lid. Nil.

3 shrapnel shells.
9 filled cartridges in cartouch.
3 common shells.
1 camp kettle, under.
On inside of Lid. Nil.

On top of lid of Box.
2 blankets.
1 cover, wa-
terproof.

28 lb. grease in two magazine
boxes, under.
1 maul, under.

On inside of Lid.

2 portfires.
1 bold-rod, with 3 needles, and 2 oz. Worsted.

Weight with Mark I, bodies about 42 cwt. 8 qr. 0 lb.

" " " " 42 cwt. 8 qr. 80 lb.

3 shrapnel shells.
9 filled cartridges in cartouch.
3 common shells.
1 camp kettle, under.
On inside of Lid. Nil.

On top of lid of Box.
2 blankets.
1 cover, wa-
terproof.

3 shrapnel shells.
9 filled cartridges in cartouch.
3 common shells.
1 camp kettle, under.
On inside of Lid. Nil.

On top of lid of Box.
2 blankets.
1 cover, wa-
terproof.

1 box, under, containing—
Slow match. Merline.
Hambro' line. Twine whipping.
Linch pin.

On inside of Lid.

2 couples, trace.

2 portfires.

Note.—Each shell is supplied with a lifting strap.

RANGE TABLE.

Projectile—Common Shell or Shrapnel 25 lb. (no gas check).

Range. yards.	Elevation. ° ′ ″	Angle of Descent. ° ′ ″	Remaining Velocity. f. s.	5 mins. elevation in- creases or decreases the range by yards.			50 per cent. of rounds should fall within* 5 mins. will alter point of impact vertically or laterally at each range.			Length. yards.	Breadth. yards.	Height. yards.	Time of Flight. secs.	Dangerous zone for a Height of 6 Feet. yards.	Fuse.	Scale.
				yards.	yards.	yards.	secs.	Time of Flight. secs.	Dangerous zone for a Height of 6 Feet. yards.							
0	0 8	0 10	1,350	...	...	...	...	...	...	210	1	...	...	...	...	...
100	0 8	0 10	1,317	50·0	0·14	5·6	0·07	0·10	0·25	300	1·5	...	...	...	...	...
200	0 18	0 20	1,284	50·0	0·29	10·0	0·14	0·20	0·51	380	2·5	...	...	...	...	...
300	0 28	0 30	1,252	50·0	0·43	14·5	0·21	0·35	0·78	460	3·5	...	...	...	...	...
400	0 38	0 42	1,220	45·4	0·58	18·5	0·28	0·50	1·05	540	4·5	...	...	...	...	...
500	0 48	0 54	1,188	45·4	0·72	22·0	0·35	0·65	1·32	620	5·5	...	...	...	...	...
600	1 0	1 6	1,162	41·6	0·87	25·0	0·42	0·80	1·60	700	6·5	...	...	...	...	...
700	1 12	1 20	1,137	41·6	1·01	28·0	0·49	1·00	1·88	780	7·5	...	...	...	...	...
800	1 24	1 34	1,112	41·6	1·16	30·5	0·56	1·20	2·15	860	8·5	...	...	...	...	...
900	1 36	1 50	1,087	38·4	1·31	33·0	0·64	1·40	2·45	940	9·5	...	...	...	...	...
1,000	1 49	2 8	1,062	38·4	1·45	35·0	0·72	1·70	2·75	1,020	10·5	...	...	...	...	...
1,100	2 2	2 27	1,042	35·7	1·60	37·0	0·80	1·95	3·05	1,100	11·5	...	...	...	...	...
1,200	2 16	2 43	1,021	35·7	1·74	39·0	0·88	2·20	3·30	1,180	12·5	...	...	...	...	...
1,300	2 30	3 6	1,016	33·3	1·89	41·0	0·96	2·50	3·61	1,260	13·5	...	...	...	...	...
1,400	2 45	3 26	1,001	33·3	2·03	42·5	1·04	2·85	3·92	1,340	14·5	...	...	...	...	...
1,500	3 0	3 45	986	31·2	2·18	44·0	1·12	3·20	4·25	1,420	15·5	...	...	...	...	...
1,600	3 16	4 8	973	31·2	2·32	45·5	1·21	3·55	4·58	1,500	16·5	...	...	...	...	...
1,700	3 32	4 32	960	31·2	2·47	47·0	1·30	3·95	4·91	1,580	17·5	...	...	...	...	...
1,800	3 48	4 58	947	31·2	2·61	48·0	1·39	4·35	5·25	1,660	18·5	...	...	...	...	...
1,900	4 4	5 24	934	31·2	2·76	49·0	1·48	4·80	5·60	1,740	19·5	...	...	...	...	...
2,000	4 20	5 52	922	29·4	2·91	50·0	1·57	5·25	5·95	1,820	20·5	...	...	...	...	...
2,100	4 37	6 20	910	27·7	3·05	51·0	1·66	5·75	6·30	1,900	21·5	...	...	...	...	...
2,200	4 55	6 50	899	27·7	3·20	52·0	1·75	6·25	6·65	1,980	22·5	...	...	...	...	...
2,300	5 13	7 20	888	26·3	3·34	53·0	1·85	6·80	7·01	2,060	23·5	...	...	...	...	...
2,400	5 32	7 52	877	26·0	3·49	54·0	1·95	7·40	7·39	2,140	24·5	...	...	...	...	...
2,500	5 52	8 24	866	25·0	3·63	55·0	2·05	8·00	7·75	2,220	25·5	...	...	...	...	...
2,600	6 12	8 58	856	23·8	3·78	56·0	2·15	8·70	8·12	2,300	26·5	...	...	...	...	...
2,700	6 33	9 22	846	22·7	3·92	57·0	2·25	9·40	8·50	2,380	27·5	...	...	...	...	...
2,800	6 55	10 6	836	22·7	4·07	58·0	2·35	10·25	8·89	2,460	28·5	...	...	...	...	...
2,900	7 17	10 42	826	21·7	4·21	59·0	2·45	11·20	9·28	2,540	29·5	...	...	...	...	...
3,000	7 40	11 20	817	21·7	4·36	60·5	2·55	12·25	9·64	2,620	30·5	...	...	...	...	...
3,100	8 8	11 68	808	21·7	4·51	62·0	2·65	13·50	10·03	2,700	31·5	...	...	...	...	...
3,200	8 26	12 18	799	20·8	4·65	63·5	2·75	14·90	10·42	2,780	32·5	...	...	...	...	...
3,300	8 50	13 20	790	20·0	4·80	65·0	2·85	16·10	10·82	2,860	33·5	...	...	...	...	...
3,400	9 15	14 4	781	18·5	4·94	66·5	2·96	17·45	11·23	2,940	34·5	...	...	...	...	...
3,500	9 42	14 50	772	18·5	5·09	68·5	3·07	18·80	11·65	3,020	35·5	...	...	...	...	...
3,600	10 9	15 26	763	18·5	5·23	70·5	3·18	12·07	7·00	3,100	36·5	...	...	...	...	...
3,700	10 35	16 24	754	17·8	5·38	72·5	3·29	...	12·40	3,180	37·5	...	...	...	...	...
3,800	11 4	17 14	746	17·8	5·52	75·0	3·40	...	12·91	3,260	38·5	...	...	...	...	...
3,900	11 32	18 4	738	17·2	5·67	77·5	3·52	...	13·38	3,340	39·5	...	...	...	...	...
4,000	12 1	18 57	730	16·6	5·81	80·0	3·64	...	13·75	3,420	40·5	...	...	...	...	...
4,100	12 31	19 51	722	16·1	5·96	82·0	3·76	...	14·17	3,500	41·5	...	...	...	...	...
4,200	12 2	20 48	714	15·6	6·11	84·0	3·88	...	14·58	3,580	42·5	...	...	...	...	...
4,300	13 34	21 48	706	15·1	6·25	89·5	4·00	...	15·02	3,660	43·5	...	...	...	...	...
4,400	14 7	22 52	698	15·1	6·40	93·0	4·18	...	15·45	3,740	44·5	...	...	...	...	...
4,500	14 40	23 59	691	14·7	6·54	97·5	4·26	...	15·90	3,820	45·5	...	...	...	...	30
										4,420						

* Four times these dimensions will give the spaces (longitudinal, lateral, or vertical), in which the whole of the rounds should strike. Any two multiplied together will give the area in which 25 per cent. should strike. The calculations are based on the supposition that the mean point of impact is in the centre of the figure.

The elevation and length of time fuze corresponding to various distances are given by graduations on tangent bar.

These graduations, however, have only an approximate value, as the data upon which they are based were obtained by experiments carried out at Shoeburyness under certain conditions of weather, powder, fuze, &c., and a change in atmospheric conditions, strength of powder, or age of fuze, would probably necessitate a corresponding change in elevation to be given and length to be bored.

The graduations, therefore, must be looked upon merely as a guide, and the officer superintending the practice must always use his discretion in making such changes from the given elevations and lengths of fuze as he may consider necessary.

INSTRUCTIONS FOR PREPARING AND FIXING FUZES, &c.

(See *Army Circular*, 1880, Cl. 177.)

Fuze, Percussion, R.L.

These fuzes require no preparation except the removal of the safety-pin,—they are screwed firmly into the fuze-hole by means of the "Key, iron, " plug, G.S."

The safety-pin must not be removed until the shell is placed in the muzzle of the gun.

Fuze, Time, Wood, Boxer, Muzzle-Loading.

Preparing.

The fuze is prepared for any desired time of flight by boring through the "side hole" corresponding to the required time into the composition.

When using the hook-borer place the fuze in the hook of the hook-borer in the proper position for boring the required hole;* enter the bit into the side-hole, screwing up until the bit has entered as far as the borer will allow, taking care not to press upon the fuze so as to prevent its bedding fairly in the hook.

Unscrew, and when the bit is quite clear remove the fuze from the hook. The length of the bit is so regulated that, when placed in the handle, it will enter sufficiently far into the composition when screwed down to the shoulder. If the bit should become unserviceable the handle must be detached from the shank and the tightening screw unscrewed, the square hole in the hook being made for that purpose. Care must be taken when substituting another bit that it is properly placed in the handle, and that the tightening screw firmly presses upon it, for if any space be left between the handle and the head of the bit the end will not enter a sufficient depth into the composition. The borer should be occasionally examined and cleaned. The operation of preparing the fuze and fixing it in the shell takes, on an average, about 15 seconds; with a little practice these operations may be performed in a shorter time.

Fixing the Fuze.

The fuzes are fixed in the fuze-hole by screwing the fuze round by hand until it is held firmly in the fuze-hole, or by giving the head of the fuze two or three smart taps with a mallet, or suitable piece of wood, or by striking them against the gun-carriage, if more convenient: this operation should be performed fairly, and not so as to split or injure the top of the fuze: the fuze must not be uncapped until the shell is placed in the muzzle of the gun.

* The hook is conical to fit the fuze.

The fuzes are "uncapped" by taking hold of the small end of the copper band which is left exposed, and unwinding from left to right smartly, so as to thoroughly detach the band from the head of the fuze and to leave the priming fully exposed.

Wad, papier mache, in fuze-hole.

When fixing fuzes in shells having a wad in the fuze-hole, it is not necessary to remove the wad, as the explosion of the fuze is sufficient to force it into the shell, if using percussion fuzes; and if using wood time fuzes, the wad can be driven into the shell in the operation of fixing the fuze.

Extracting Wood Fuzes.

Apply the fuze-extractor to the head of the fuze and unscrew.

I. DEFINITION OF GUNNERY TERMS.

Calibre.—The diameter of the bore. In rifled guns it is measured across the lands.

Axis of the Piece.—An imaginary line passing down the centre of the bore.

Axis of the Trunnions.—An imaginary line passing through the centre of the trunnions at right angles to the axis of the piece.

Windage.—The difference between the diameter of the bore and that of the projectile.

Trajectory.—The curve described by the projectile in passing from the muzzle of the piece to the first point of impact.

Range.—The distance from the muzzle of the piece to the intersection of the trajectory with the line of sight.

Line of Sight.—An imaginary line passing through the sights of the piece and the point aimed at.

Line of Fire.—An imaginary line joining the muzzle of the gun and the object fired at. This term would be used instead of the preceding one if firing from behind cover or in any other case when the sights of the gun are not used.

Plane of Sight.—The vertical plane passing through the line of sight.

Angle of Sight.—The angle which the line of sight makes with the horizontal plane.

Angle of Elevation.—The angle which the line of sight makes with the axis of the piece.

Quadrant Angle.—The angle which the axis of the piece, when laid, makes with the horizontal plane. It is termed *quadrant elevation* or *depression* according as the piece is laid above or below the horizontal plane.

Line of Departure.—The direction in which the projectile is moving on leaving the piece, in other words a tangent to the trajectory at the muzzle.

Plane of Departure.—The vertical plane passing through the line of departure.

Angle of Departure.—The angle between the line of departure and the horizontal plane. The excess of the angle of departure above the quadrant angle is commonly called the *jump*.*

Angle of Projection.—The angle between the line of departure and the line of sight.

Angle of Descent.—The angle which a tangent to the trajectory at the first point of impact makes with the horizontal plane.

Lateral Deviation.—The perpendicular distance of the point of impact of the projectile right or left of the plane of sight.

* When a gun is fired, the whole system has a tendency to revolve in a vertical plane round the point of the trail or rear trucks; this lifting in front gives rise to the "jump."

Drift.—The constant deflection of a projectile from the plane of departure due to the rotation imparted by the rifling of the piece. It is sometimes termed *derivation*.

Point Blank.—A gun is laid point blank when the line of sight is parallel to its axis. Point blank range is the range due to the jump of the gun.

Muzzle Velocity.—The velocity in feet per second with which a projectile leaves the piece from which it is fired.

Remaining Velocity.—The velocity of a projectile at any given point of its trajectory.

Striking Velocity.—The velocity of a projectile at the point of impact.

Terminal Velocity.—The maximum velocity which it is possible for a given projectile to acquire by falling through the air.

The following are the natures of artillery fire :

1. With Reference to the Vertical Plane.

Direct Fire.—Fire from guns with service charges at all angles of elevation not exceeding 15°.

Indirect or Curved Fire.—Fire from guns with reduced charges and from howitzers and mortars at all angles of elevation not exceeding 15°.

High Angle Fire.—Fire from guns, howitzers, and mortars at all angles of elevation exceeding 15°.

2. With Reference to the Horizontal Plane.

Frontal Fire.—The line of fire perpendicular to the front of the object fired at.

Oblique Fire.—The line of fire inclined to the front of the object fired at.

Enfilade Fire.—The line of fire parallel (or nearly so) to the front of the object fired at.

Reverse Fire.—When the rear instead of the front of the object is fired at.

DRILL WITH 25-Pr. R.M.L. GUN.

The detachment consists of nine numbers, and falls in two deep in rear of the gun, which is limbered up.

To Tell Off.

Officer.

Tell Off.

No. 1.

At "Tell off"—No. 1 (who is on the left of the detachment) takes a pace to his front, turns to his right, and numbers himself 1; the right-hand man of the rear rank numbers 2; the right-hand man of front rank 3; the second man from the right of the rear rank 4; the man in his front 5, and so on; after the detachment is told off No. 1 falls in again on the left of the front rank.

No. 1 then straps on the fuse pocket on his right side, and 5 the tube pocket.

The front is that direction in which the gun is pointed when unlimbered, or to which, when limbered up, the horses' heads are turned.

Position of Detachment when Limbered up.

In Order of March.

No. 1 in line with the point of the near shaft and two yards on the left of it.

Nos. 2 and 3 in line with the axletree of the gun carriage.

Nos. 4 and 5 in line with the centre of the trail.

Nos. 6 and 7 in line with the axletree of the limber.

Nos. 8 and 9 in line with the splinter bar.

The Nos. stand covering, one yard from the wheels. (Fig. 1.)

Fig. 1.



In Front.

Two deep, two yards in front of the shafts or horses' heads.

In Rear.

Two deep, two yards in rear of the muzzle of the gun.

Right or Left.

Two deep, in line with the gun axletree, one yard to the right or left of the wheel.

Exercise with Drag Ropes.

When drag ropes are used Nos. 6 and 7 pass them towards 2 and 3, who hook them to the drag washers of the gun on their own side, all the Nos. manning them on their own sides. No. 9 in the shafts.

Extra numbers will be required to draw the carriage.

Change of Position of Detachments.

To form the Order of March from Detachment Front.

Officer.

No. 1.

Form the order of march.

Right turn, Double march.

"Right turn, Double march."—No. 1 turns with the detachment; 2 and 3 wheel to their right and open out. Each number halts when at his post; they turn to the front together, looking to No. 2, who turns about immediately he arrives at his station.

To form the order of March from Detachment Rear,

Right or Left.

Officer.

No. 1.

Form the order of march.

Left turn, Double March.

When the detachments are in rear or on the right, they proceed direct; but when on the left they countermarch to the left. No. 1 heads the rear rank. Each number halts when at his post.

To Change from Front to Rear.

<i>Officer.</i>	<i>No. 1.</i>
<i>Detachment rear.</i>	<i>Right turn, Double march.</i> <i>Rear turn.</i> <i>Right turn, Halt, Front.</i>

When the detachment is clear of the gun it turns to the rear ; when in line with the position of " *Detachment rear* " it turns to the right ; and when in rear of the muzzle it halts and fronts.

To Change from Rear to Front.

<i>Officer.</i>	<i>No. 1.</i>
<i>Detachment Front.</i>	<i>Right turn, Double march.</i> <i>Front turn.</i> <i>Left turn, Halt, Front.</i>

When the detachment is clear of the gun it turns to its front ; when in line with the position of " *Detachment front* " it turns to its left ; and when in front of the leading horses it halts and fronts.

To Change from Rear to Right or Left.

<i>Officer.</i>	<i>No. 1.</i>
<i>Detachment right (left.)</i>	<i>Right (left) turn, Double march.</i> <i>Front turn, Halt.</i>

The detachment turns to its front when one yard clear of the gun wheel, and halts when in line with the axistree.

To form Detachment Rear from the Order of March.

<i>Officer.</i>	<i>No. 1.</i>
<i>Detachment rear.</i>	<i>Right about turn, Double march.</i> <i>Halt, Front.</i>

Nos. 2 and 3 close to the centre, and wheal to their left, marking time when opposite the off wheel and two yards from it ; as soon as the detachment has closed up it is halted and turned to the front.

To form Detachment Front from the Order of March.

<i>Officer.</i>	<i>No. 1.</i>
<i>Detachment front.</i>	<i>Double March.</i> <i>Halt, Front.</i>

No. 1 doubles out two yards in front of the near shaft, turns to his right, and gives the order " *Double march*." Nos. 8 and 9, followed by the other Nps, double out. As soon as 8 is clear of the shafts, he inclines towards 9. When 8 and 9 arrive in line with No. 1 they wheel to their left, and mark time ; when the detachment is closed up, No. 1 gives " *Halt, front*," turning himself to the front at the same time.

To Change Rounds when the Gun is Limbered up.

The detachment being at the "order of march" in changing rounds.
No. 2 becomes 4 ; 4, 6 ; 6, 8 ; 8, 1 ; 1, 9 ; 9, 7 ; 7, 5 ; 5, 3 ; 3, 2.

To Unlimber.

This must be done when the gun is in the firing trunnion holes.

<i>Officer.</i>	<i>No. 1.</i>
<i>Unlimber.</i>	<i>Prepare to unlimber.</i>
	<i>Lift.</i>
	<i>Limber drive on.</i>
	<i>Lower.</i>

"*Prepare to unlimber.*"—No. 1 unkeys the keep chain, and with 2, 3, 4, 5, 6 and 7 stands to the trail, 2 and 3 nearest the gun. If there are no horses 9 goes to the shafts and 8 to the splinter bar on the near side.

At "*Lift*" the trail is lifted clear of the pintail; at "*Limber drive on*" the limber moves on, and at "*Lower*" the trail is lowered to the ground.

To Limber up.

<i>Officer.</i>	<i>No. 1.</i>
<i>Limber up.</i>	<i>Prepare to limber up.</i>
	<i>Lift.</i>

The several numbers place themselves as for unlimbering, and at "*Lift*" lift the trail on to the pintail, No. 1 keys up.

When unlimbering or limbering up guns mounted on overbank carriages, great care should be taken *not to raise the trail too high*, as it is apt to fly up and escape from the control of the men lifting it, in which case the gun pitches violently over on to its muzzle, and may become dismounted.

SHIFTS.

To Shift a 25-pr. R.M.L. Gun on Overbank Carriage from Firing to Travelling Trunnion Holes.

This must be done while the gun is limbered up.

Strength of Detachment.—This may be done with one gun detachment, but in shifting from travelling to firing trunnion holes it is advisable to employ two, as the work is heavy.

Stores required.—The stores required in addition to those on the gun are as follows, viz.:

Drag-ropes, heavy	...	...	...	...	...	2
Luff tackles, complete	...	...	...	...	...	2
Key, crossed-handled, removing arcs	...	...	...	...	...	1

<i>Officer.</i>	<i>No. 1.</i>
<i>Shift from firing to travelling trunnion holes.</i>	<i>Prepare to shift the gun.</i>
	<i>Hook tackles.</i>
	<i>Prepare to bear down.</i>
	<i>Bear down.</i>
	<i>Come up.</i>
	<i>Prepare to lift.</i>
	<i>Lift and heave.</i>
	<i>Halt.</i>
	<i>Lower.</i>
	<i>Prepare to bear down.</i>
	<i>Bear down.</i>
	<i>Heave and ease off.</i>
	<i>Cast off tackles.</i>

Prepare to shift the gun.—2, 3, 4 and 5 cast loose side arms, handspikes, remove elevating arc and capesquares; 4 scotches the wheels in front; 5 in rear. 8 and 9 lash trail-eye to axletree bed of limber with a drag-ropes.

Hook tackles.—No. 1 fixes breech loop; 4 and 5 hook double blocks to it; 6 and 7 the single blocks to breast of carriage; 4 and 5 stand ready to ease off; 9 makes fast a drag-ropes to the rear patch and passes it to the front to 8.

Prepare to bear down.—2 places a handspike in bore, makes fast a drag-ropes to the end of it; 3 double mans; 6 hands roller to 1.

Bear down.—2 and 3 bear down; No. 1 places the roller.

Come up.—The breech is lowered on to the roller; 6, 7, 8 and 9 man the breech drag-ropes; 2 and 3 stand ready for lifting; 4 and 5 to ease off.

Lift and heave.—2 and 3 lift the muzzle; 4 and 5 ease off; 6, 7, 8 and 9 haul on breech drag-ropes until the trunnions are over the upper surfaces of the brackets, when No. 1 gives

Halt. Lower.—The trunnions are lowered to bear on the flat part of the brackets.

Prepare to bear down.

Bear down.—2 and 3 bear down; No. 1 removes the roller.

Heave and ease off.—4 and 5 ease off; 6, 7, 8 and 9 heave on breech drag-ropes; 2 and 3 steady the muzzle.

Cast off tackles.—The tackles are cast off by the same numbers that hooked them, the gun is secured by straps to the carriage for travelling.

To Shift from Travelling to Firing Trunnion Holes.

Officer.

No. 1.

Shift from travelling to firing trunnion holes.

Prepare to shift the gun.

Hook tackles.

Arrange muzzle handspike.

Taut. Heave.

Cast off tackles.

"Prepare to shift the gun."—2, 3, 4, and 5 cast loose side arms, handspikes, &c.; 4 and 5 scotch the wheels as before.

Hook tackles. Arrange muzzle handspike.—2, 3, 4, 5, 6, and 7 as before; 9 makes fast a drag-ropes to rear patch, takes a turn round the axletree-bed of limber, and hands running end to 8; 5, 7, and 9 man the fall on the right of the gun; 4, 6, and 1 on left.

Taut. Heave.—4, 5, 6, 7, 8, and 1 heave the gun up until the trunnions are on the upper surface of the brackets of carriage; 2 and 3 steady the muzzle as before, when 6 and 7 fall off and place the points of handspikes in the trunnion holes to receive the trunnions; 8 easing off carefully. As soon as the trunnions drop on to the handspikes, No. 1 gives

Cast off tackles.—This is done by the numbers that hooked them; 6 and 7 working out their handspikes.

Clerk's Platform.

Clerk's platforms are carried and laid by the Royal Artillery.

Each consists of—

Two inclined planes, a' (vide sketch), $17' \times 12''$, with a slope of 3° and iron pins to pivot them to the front transoms. Two front transoms (b'), each $7' \times 16'' \times 4''$, to which the inclined planes are pivoted. One centre transom (c) $7'' \times 16'' \times 4''$. One rear transom (d) $10' \times 16'' \times 4''$. One trail plank (g), $8' \times 16'' \times 4''$, shod with iron. Two front stops. Two rear stops.

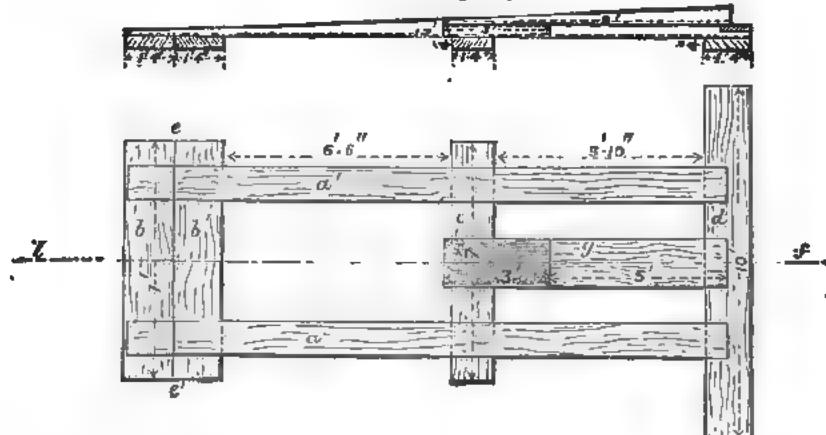
The platform weighs about 14 cwt.

Entrenching Tools, &c., required:—4 picks, 2 spades, 4 shovels, 2 rammers, 4 banderols or pickets, 1 maul, 1 field level or quadrant, 1 measuring tape.

The line of fire ($l f$) having been ascertained and marked by pickets or banderols, the front transom (b) is laid at right angles to it, in the centre of

the gun portion 6 inches from foot of the interior slope of the parapet ; this is done by making the distances ef , $e'f$, from ends of the transom to any point f in the line of fire equal. The transom should be flush with the ground, and laid horizontal by aid of a field level.

Section through 1 f.



A second front transom (b') is then laid in rear of and close to the first, after which the centre and rear transoms in succession, each being carefully levelled with regard to the others.

The front of the centre transom should be 6' 6" from the rear of the front ones. The rear transom at such distance from the front that the ends of the inclined planes will rest on them sufficiently to admit of being traversed with handspikes bearing on the top of the transom.

The ground between the transoms having been well rammed, the side pieces are laid ribands *inside*, and pivotted to the outer holes in the front transom by means of two iron pins.

Iron stops are then fitted on the front ends of the side pieces, to prevent the gun being run up too far.

Similar stops on the rear ends to check recoil.

The trail plank is then placed between the side pieces, the iron-shod portion of it to the front, and resting on the centre transom.

The line of fire should then be marked in the centre of the platform, either by means of a light batten 7 feet long, with pencil line down the centre, and secured in the ground by long nails, or by means of a piece of fine cord, chalked and secured in a similar manner. In either case, batten or cord, indicating the line of fire, should be slightly above and independent of the transoms, to prevent its shifting on the shock of discharge.

The easiest mode of mounting the gun is to remove the rear stops from the inclined planes, and run the gun up from the rear on an incline of quoins or skidding with planks on them.

To Take Post under Cover.*

Officer.

No. 1.

Take post under cover.

Right turn. Double march.

The detachment wheels to its left, the front rank filing to the left of the gun, the rear rank to the right ; 2 and 3 halt close to the parapet on the right and left of the platform ; 4 and 5 form up on their right and left, and the whole turn to the right about together. No. 1 follows in rear of the detach-

* If the gun is not behind a parapet and the word of command is "Take post at the gun," the detachment wheels to its left, as before, 2 and 3 halt in line with the front of the wheels. 4 and 5 with the rear of the wheels, No. 1 in rear of the gun, 6, 7, 8, 9 at the limber.

ment, keeping under cover as much as possible ; 6 and 8 go to the cartridge store ; 7 and 9 to the shell store.

General Duties.

No. 1 commands, directs, or superintends boring and fixing fuzes, assists to run up, and lays.

No. 2 searches, sponges, rams home, runs up, and traverses.

No. 3 loads, uncaps or removes safety pin from fuze when in bore, rams home, runs up, and traverses.

No. 4 attends to side arms and supplies them to 2, runs up, and elevates.

No. 5 attends to vent, runs up, makes ready, and fires.

No. 6 supplies 3 with cartridges.

No. 7 attends to fuzes and brings up projectiles.

No. 8 attends to cartridge store, and serves out cartridges to 6.

No. 9 attends to shell store, issues shells, tubes, and fuzes.

The instructor should ascertain that each No. is at his post by proving. This he does by calling out No. 1 "*Prove*," No. 2 "*Prove*," &c. The man called upon raises his right arm and extends it smartly to the front, hand open, thumb upwards, hand as high as the shoulders. When the next No. is called he drops his hand. The last No. lowers his hand at the word "*Down*."

On all occasions before giving a word of command, No. 1 should repeat the number of his gun.

At the sound or order "*Stand fast*" when a gun is loaded it will remain so, if in the act of being loaded, the loading will be finished and the gun not fired until the order to recommence firing is given.

Loading should be performed as rapidly as is consistent with the proper performance of all the duties, avoiding confusion.

The cartridge should be kept covered until the sponge is out of the bore.

If a shell jams in the bore, and cannot be got out by lowering the muzzle, the cartridge must be drowned and the charge blown out by the introduction of a small quantity of powder poured into the vent.

No gun is to be fired without the order of the No. 1.

When the order "*Cease firing*" is given, the loaded guns are either to be discharged or unloaded at directions from the commanding officer.

To Prepare for Action.

Officer.

Prepare for Action.

No. 1.

Prepare for action.

Examine gun.

"*Prepare for action.*"—The stores are brought up as follows :

No. 1, handspike and sights.

No. 2, handspike, and assists 4 with side arms.

No. 3, handspike, removes the tampon from the muzzle.

No. 4, handspike, side arms, and support for head of side arms.

No. 5, handspike, tubes in pocket, lanyard, pricker and vent server.

No. 6, two cartridges cases, which he leaves at the cartridge store, bucket filled, and brush. (For drill purposes two drill cartridges.)

No. 7, fuzes and fuze and shell implements. He obtains the fuze boxes from 9, having ascertained from No. 1 the fuzes required ; and satisfies himself as to the correctness of fuzes and fuze implements. He places the fuze boxes on the shell benches in the covered way on left of gun portion where the shells are fuzed.

No. 8 prepares to issue cartridges.

No. 9 provides a brush, prepares to issue shells, friction tubes, and fuzes. He examines the shells carefully, cleaning them if necessary and removing burrs from studs ; he loosens the fuze-hole plugs of shells that will be first issued and sees that the gas-checks are properly fitted.

The stores having been brought up, No. 1 will satisfy himself that the fore sights fit properly on the gun and the deflection leaves of the hind sights work easily; he receives the reports from the Nos. responsible for any irregularity or deficiency in connection with the gun, ammunition, or stores.

The sponge, rammer, and wadhook are laid on the ground clear of the platform, to the right of the gun and parallel to it, heads to the rear, resting on the support supplied by 4, sponge nearest the gun.

The sponge bucket near the sponge head.

The handspikes are laid down, two on each side of the gun close to the carriage, points to the front, bevelled side uppermost, those of 2 and 3 outside, and about two feet in advance of those of 4 and 5. No. 1's handspike in rear of the platform.

No. 3 examines the bore to see the grooves are free from grit, &c.

No. 4 ascertains that the elevating gear is in working order (should the elevating arc have been detached from the carriage he brings it up and adjusts it).

No. 5 strays the tube pocket round his waist on the right side, coils up the lanyard, and passes the bight of it through the tube pocket strap; examines the vent server, and places it in the vent, the loop of the vent server lanyard over one of the sights; he fills his tube pocket with friction tubes which he procures from 9, and places the pricker in the loop on the carriage.

N.B.—Should the stores be on the gun, they are unstrapped and laid down as above detailed.

"Examine gun."—No. 5 drifts the vent, replaces the pricker in the loop and the vent server. 2 supplies himself with the wadhook, searches the gun after the pricker has been withdrawn, and replaces wadhook. 4 attends to the elevating wheel to bring the gun into a convenient position for loading.

To Load.

Officer.

Range—yards.

No. 1.

With—load.

"Load."—No. 1 gives 7 the nature of shell and fuze required and during the loading fixes his tangent scale at the required elevation. He places himself in a convenient position, near the muzzle, whence he can watch the loading and observe, by the mark on the rammer, if the shell is home.

No. 2 places himself in a convenient position for sponging. He places his left foot in line with and about 12 inches from the muzzle, steps to his right with his right foot, and looks to his left rear, takes the sponge in a horizontal position from 4, left hand back down, right hand back up, brings it in line with the axis of the gun, enters the head into the bore, being careful to observe that the vent server is in the vent, slides his hands along the stave to his right as far as he can reach, sends the sponge up the bore, slides his hands out again and forces the sponge hard home, gives it two half turns pressing it against the bottom of the bore, withdraws the sponge, hand over hand, turning it from him, cleaning the bore well. When the sponge arrives near the muzzle, he jerks it out, his hands then should be in the position they were in when he introduced the sponge into the bore. He then hands the sponge to 4 and receives the rammer, right hand about the centre back down, left as near the head as possible back up; as soon as the cartridge and shell are put in, he enters the head into the bore and forces them home hand over hand. He then springs the rammer, steps out, hands it to 4 and goes under cover.

No. 3, as soon as the sponge is withdrawn, takes the cartridge from the cartridge case with his left hand, moves up and places it in the bore, he then slew his body to his right and receives a shell from 7 and puts it in the bore, withdraws the safety pin, or uncaps the fuze, places himself in a corresponding position to 2 and assists him to ram home; when the cartridge and projectile are home he quits the stave and goes under cover.

No. 4 doubles out, halts in line with the sponge head, turns to his left, picks up the stave with his right hand back under, 6 inches from the head, turns

three-quarters left about, and in doing so lifts the sponge over his head, allowing the end of the stave to rest on the ground. His left hand meets the stave close to the sponge, his right hand is slipped up the stave about two feet. He then moves towards the muzzle and places the sponge in a convenient position for 2 to lay hold of, waiting for its return at the left rear of 2 facing the gun. When he receives the sponge from 2 he allows the end of the stave to fall on the platform, steps to his left, turns three-quarters right about, passing the sponge over his head, lays it down, takes up the rammer as before detailed for the sponge and hands it to 2. He then remains in position to receive the rammer as soon as 2 has sprung it. He lays it down as he did the sponge and goes under cover.

No. 6 brings up a cartridge in a case and places it on the ground on 3's right front; after the sponge is withdrawn he uncovers it, and as soon as 3 has withdrawn the cartridge, 6 takes the case back to the cartridge store.

No. 7 brings up a shell point to his right, having fixed the fuze according to No. 1's direction, and hands it to 3.

No. 8 issues a cartridge to 6.

No. 9 issues a shell to 7.

To Run Up.

Directly the gun is loaded, No. 1 gives "Run up," and applies his handspike at the trail eye to guide the gun.

Nos. 2, 3, 4, 5 take up their handspikes; 2 and 3 apply theirs horizontally over the spokes of the wheels in front, and under the bracket, close to the breast, and bear down; 4 and 5 use theirs as levers of the second order under the rear part of the wheels. All four numbers face to the rear.*

When the gun is run up, No. 1 gives "Halt," slides his handspike to the rear clear of the recoil, and looks over the sights steadyng himself by leaning on the caecable. 2 and 3 go to the end of the trail facing to the rear ready to traverse, 4 and 5 lay down their handspikes, 4 goes to the elevating wheel, 5 prepares a tube.

To Lay the Gun.

<i>Officer.</i>	<i>No. 1.</i>
	<i>Elevate.</i>
	<i>Depress.</i>
	<i>Halt.</i>
	<i>Trail right.</i>
	<i>Trail left.</i>
	<i>Halt.</i>

At "Elevate" or "Depress," 4 turns the wheel in the required direction till the word "Halt."

At "Trail right," 3 heaves over the trail, at "Trail left" 2, till the word "Halt."

At "Extreme right or left," 2 and 3 apply their handspikes and with 4 and 5 heave over the inclined planes, drawing out the iron bolts in the rear for the purpose; when it is necessary to shift the trail plank, 2 and 3, using the side pieces as fulcrums, place the points of their handspikes under the trail handles and then raise the trail; 4 double man's 2's handspike, 1 and 5 shifts the plank.

If it is necessary to run the gun back, at "Run back" 2 and 3 apply their handspikes in front of the wheels, using them as levers of the second order: 4 and 5 take a purchase with theirs over the most horizontal spokes in rear and under the brackets; the whole facing to the rear.

Should no order to fire be given, when the gun is laid, No. 1 gives the order "Under cover."

* Running back at Drill is the converse of the preceding.

To Make Ready and Fire.

<i>Officer.</i>	<i>No. 1.</i>
<hr/>	<hr/>
<i>Fire—rounds.</i>	<i>No.—Ready.</i>
	<i>No.—Fire.</i>

No. 1 lowers his tangent scale, except when firing at a moving object, and gives "Ready"; 5 presses the tube into the vent with his right thumb, steps clear of the recoil, shifts the lanyard to his right hand and extends it, keeping his hand level with the vent, facing the gun.

As soon as "Ready" is given, 2 and 3 lay down their handspikes and with 4 go under cover.

At "Fire" 5 draws the lanyard strongly towards his body, without a jerk; he then drifts the vent, replaces the vent server and goes under cover.

No. 1 does not again give "Load" until 5 has replaced the vent server.

GUNS ON OVERTANK CARRIAGES.

The service of the guns is the same as that just detailed, with the following exceptions:

The gun is run up till the muzzle is three or four feet from the parapet to load: 3 then depresses the muzzle (by means of the elevating wheel which is in front of the carriage) till it is about a foot below the interior crest.

A wire rope sponge and jointed rammer stave are used. The sponging is performed in the ordinary manner. The rammer is handed to 2 folded up. It is passed into the bore one length at a time, the second length being straightened out, and the collar slipped over the joint when the end of the first length reaches the muzzle, and so on. Withdrawing it is the converse of the above.

The rammer should be turned in entering and withdrawing it, so as to allow the portion of it outside the bore to hang downwards.

Before finally withdrawing the rammer, 2 must ascertain if the shell shows any tendency to slip forward, and, if it does so, he keeps a steady pressure on the rammer while 3 elevates till the muzzle of the gun is nearly in line with the interior crest. The rammer is then withdrawn, and 3 elevates till the axis of the gun is about 3° elevation.

The gun is then run up.

In laying, No. 1 stands on the trail. He must carefully note that the trail plank under the point of the trail is well supported. If it is not, the removal of his weight from the trail after he has finished laying will cause the trail to rise and the muzzle to be depressed. The shooting would therefore be inaccurate.

To Mount or Dismount a 25-pr. R.M.L. Gun on or from a Travelling Siege Carriage, by Up-ending the Trail.

Strength of Detachment 18 Nos. (two gun detachments).

This gun is dismounted in the same way as the 16-pr. R.M.L., except that, on account of its length, a hole is made in the ground about 18 inches deep to receive the muzzle.

Prepare to Dismount the Gun.—No. 1 removes the sights. 2, 3, 4, and 5 remove cap-squares, side arms, elevating gear, and drag shoe. 4 and 5 attach a drag-rope to the cascable by an overhand knot in the centre, passing the ends to the front. 2 and 3 man the wheels. 4, 5, and 6 stand to lift the trail. 1, 7, 8, and 9 place themselves in front of the gun and man the ropes, 1 and 8 on the right, 7 and 9 on the left.

Dismount the Gun.—The trail is raised and the wheels manned forward

till the gun is perpendicular; when the muzzle touches the ground the drag-rope Nos. steady the gun on its muzzle, having hauled it out of the trunnion holes by the drag-rope if necessary, and the carriage is run a few inches to the rear.

It is to be borne in mind that disengaging the gun from the carriage greatly increases the weight on the trail, and the men should be prepared for this.

"Lower the Trail."—The trail is lowered and the carriage run back.

"Lower the Gun."—The drag-rope is manned by all the Nos. on their own sides, outside the ropes, and the gun lowered by the Nos. walking forward with the drag-rope.

N.B.—A few additional Nos. may be with advantage employed at the trail. This method requires much caution. It is therefore preferable, whenever practicable, to have recourse to the plan of Mounting and Dismounting by means of long oak skids up or down the rear, which is easy, safe, and expeditious.

In mounting, 2 and 3 place a handspike in the bore and lift, whilst 4 and 5 place a handspike under the gun behind the trunnions, to be manned by 2, 3, 4, and 5; 6 and 7 then place the near shaft of the limber under the breech, to be manned by 6, 7, 8, and 9; the whole of the Nos. facing the muzzle. Additional Nos. man a drag-rope placed on the cascable by 4 and 5 as in dismounting, a turn being taken round the shaft with either end of the rope, the running ends coming off below; the detachment lift until the Nos. can be more advantageously employed in hauling on the rope.

The remainder of the operation is the converse of dismounting.

METHODS OF LAYING.

4.—When the objects fired at is visible over the sights—

1. *The tangent scale is used.*

No. 1 removes the tangent scale from the gun, and sets it by bringing the top of the moveable socket to the required division on the yard or degree scale, and clamping it. (Any odd number of minutes is given on the slow motion screw at the head of the scale.) If any deflection is wanted he sets the arrow on the sliding leaf to the required division and clamps it. (Any deflection required from accidental causes, such as wind, &c., must, if left, be added to, if right, be deducted from, the deflection shown in the range tables.)

No. 1 having set his scale replaces it in the gun, taking care that the socket is home.

He then lays with a full sight, i.e., he brings the top of the notch, the apex of the foresight, and the point aimed at in line.

To ensure good laying the following rules must be observed:—

The eye not to be less than one foot in rear of the tangent scale notch, if possible more, and the distance between eye and notch not to be varied from round to round.

The head to be upright and the body in an easy position, supported if possible by holding on to or resting on the cascable.

The most conspicuous point in the object to be chosen to lay at.

The operation of laying to be completed as rapidly as possible so as not to fatigue the eye.

The gun to be laid a little above the object and then depressed on to it. This ensures the teeth of the elevating arc being in bearing with the driving pinion.

If the elevating gear is unserviceable, and the gun has to be elevated by handspikes, the elevation should first be roughly obtained, 2 and 3 applying their handspikes under the breech and 4 attending to the coin, the gun being laid a little above the mark.

It is then traversed into line and the final adjustment for elevation obtained by 2 tapping the small coin with his handpike.

B.—When the object is visible from the battery, but the line of sight obscured by the parapet.

2. Laying by plumb line.

If No. 1 can see the object from some spot immediately in rear of the gun (by standing on an empty shell box, &c.), he can obtain the direction by plumb line.

He first sets the tangent scale to the required deflection. Then standing in rear of the gun he holds the plumb line so that it cuts both the sights. If the object is on the right of his line he gives "*Train left*," and *vice versa*. When the plumb line cuts both the sights and the object, the direction has been obtained.

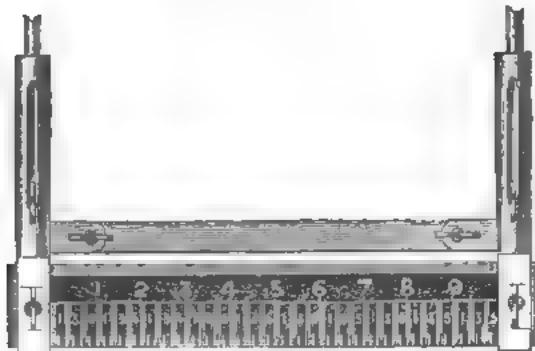
The elevation is given by quadrant or clinometer. Care must be taken in applying the quadrant so that it may always be placed in the same position on the top of the breech, and parallel to the axis of the gun.

Note.—The quadrant angle is the same as the angle of elevation when the object fired at is in the same horizontal plane as the gun. If the object is below this horizontal plane, the quadrant angle is less, if it is above, the quadrant angle is greater than the angle of elevation. If, therefore, there is a great difference of level between the firing point and the object, the angle which a straight line joining the object and firing point makes with the horizon (the angle of sight) must be ascertained, and added to or deducted from the angle of elevation (as given in the range tables), in order to obtain the quadrant angle, *i.e.*, the number of degrees and minutes at which the quadrant should be set.

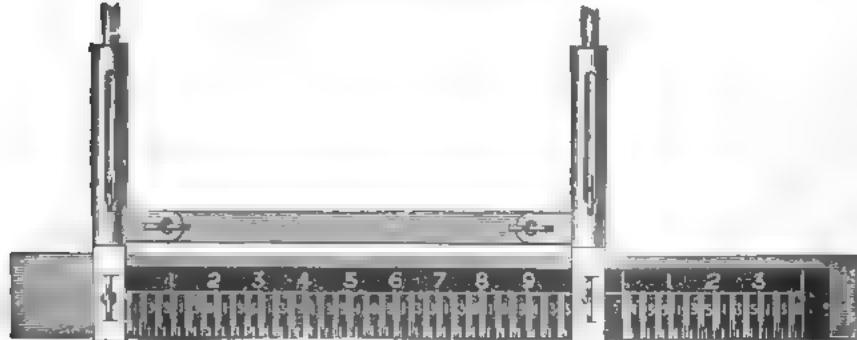
3. Laying by hanging scales.

A set of scales, consisting of a front and rear scale, with light iron rods for suspending them from the carriage, forms part of the equipment of travelling wrought iron siege carriages.

FRONT SCALE.



REAR SCALE.



The front scale hangs from the lower part of the axletree, and the rear one between the trail brackets. The scales are graduated on both sides so that they can be read from either front or rear, and as they are constructed with a view to being read from a distance, the centres of the divisions are used and not the lines marking them. Thus commencing at the left, the first division is 0, the second 5', the third 10', the fourth 15', and so on. The white divisions are all tens, the number of the ten being shown by the figure above—thus, 3 tens = 30 minutes.

The rear scale is longer than the front one, as it has a deflection scale of 4° at its right extremity.

The scales are so constructed that if corresponding divisions of both of them are over the line of direction (no allowance being made for deflection) the axis of the gun will be in a vertical plane parallel to it.

The method of using the scales is as follows:—

The line of direction having been obtained, as in § 2 (or otherwise), it is marked by a line drawn (with pencil, chalk, &c.) on the platform or on a plank or batten laid for the purpose.

The scales are adjusted so as to hang perfectly horizontally and clear of all impediments, but not too high to prevent the divisions being clearly seen in connection with the line of direction.

If the line has been obtained over the sights, as in § 2, No. 1 ascertains what division of the front scale is cut by the line, and slides the rear scale to the left until it reads the same as the front one. If the direction of the first round is good, all that is necessary in succeeding rounds is to traverse until the rear scale reads the same as the front one.

If any correction for deflection is found necessary the rear scale must be adjusted accordingly.

The scales must be removed before firing. 2 attends to the front and 4 to the rear scale.

Should the line of direction not have been obtained over the sights of the gun, then, for the first round, the deflection shown in the range tables must be given on the rear scale and the gun traversed until the two scales read the same. Any requisite correction being given after the first round as before.

The elevation is obtained by quadrant, as in § 2.

4. *Laying by an auxiliary mark in front.*

If there is a conspicuous object near the line of fire (such as a church spire) which is visible over the sights, No. 1 can, after laying the gun by the method described in § 2, put up his tangent scale and move his deflection leaf until his line of sight passes through the new object.

With the elevation and deflection thus obtained, he may lay on this auxiliary mark for the succeeding rounds.

This plan is more applicable to the howitzers than the guns, as their long deflection bars give them a larger field of view over the sights.

5. *Laying on an auxiliary mark in rear.*

This method, also called the reverse system of laying, is the converse of the last.

A conspicuous object some distance (the farther off the better) in rear of the gun is selected, and No. 1 places himself in front of the foresight and looks over this sight at the object. 4 by his directions moves the tangent scale and deflection leaf until the line is obtained.

6. *Laying by Captain French's sights.*

By this system the reverse method of laying is made applicable under all circumstances.

There are two scales, the rear one fitting into the tangent scale socket and the front one into the foresight socket of the gun.

The rear scale consists of a steel bar graduated like the tangent scale, and fitted with a moveable socket and clamp. The head of the scale is rectangular and has a slot cut in it, in which a horizontal gun-metal bar is free to slide.

The top of the horizontal bar is graduated from 0 to 8 into degrees and divisions of 5 minutes.

On the left of the bar is a deflection scale by which a deflection of 1° right and 3° left can be given.

If no deflection is required, the left zero mark is made to coincide with the left face of the head.

A sliding leaf with a triangular apex is free to move along the bar. Both horizontal bar and sliding leaf are provided with clamping screws.

The front scale has a fixed horizontal bar similar to that of the rear scale, and graduated from 0 to 8. It has also a sliding leaf with a sighting notch on the top and a clamping screw in front.

The following is the method of using the scales:—

The gun having been laid as described in § 2, No. 1 sets the rear scale to a convenient height (so that his line of sight will be approximately horizontal). He adjusts the horizontal bar without deflection, and slides the leaf to one of the divisions near the centre of the bar. He then tightens all the clamping screws and goes to the front of the front scale. He clamps the sliding leaf of this scale to the same division at which the rear one is set, and looks over his sights.

Under his direction a plumb line is suspended about 4 yards in rear of the gun and another line suspended or a mark made about 10 yards in rear of the first (or farther back if possible). The plumb line and rear mark are so placed that they are accurately in the prolongation of the line of sight, and they are adjusted at such a height that No. 1 can see them both when looking over his sights. By raising or lowering his rear scale, No. 1 can adjust his line of sight for the most convenient position of the plumb line and rear mark.

He has thus four points in line, and, by noting the height of his rear scale when he has laid on the mark, he has a means of obtaining the elevation in succeeding rounds independent of the quadrant. He removes the scales from the gun before it is fired.

After the first round he lays as follows:—

a. He gives any necessary correction in elevation and deflection on the rear scale (by the same rules as with the service sights), clamps it and inserts it in the tangent scale socket. He then unclamps the leaf and slides it to the end of the horizontal bar.

b. He goes to the front of the foresight, unclamps the leaf and slides it along the horizontal bar until the notch is in the same line as the plumb line and mark. He then clamps it.

c. Under his direction, 4 sets the sliding leaf of the rear scale so that it reads the same as the front one.

d. He lays the gun (2 and 3 traversing and 4 elevating) by giving *trail right or left* and *elevate or depress* until the line of sight cuts both plumb line and mark.

7. Laying on plumb line, &c., to the rear with service sights.

This method of laying (by plumb line and mark in rear) is applicable to the service sights. It would, however, entail a loss of time from the gun having to be cross-lifted into the original line nearly every round, but it is a useful method for howitzers mounted on beds.

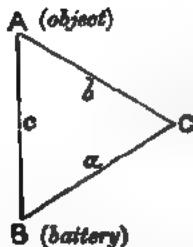
C.—When the object fired at is not visible from the battery.

8. Obtaining the line of fire.

If the object is visible from any elevated spot of ground in rear of the battery, the line may be obtained by plumb line, as in § 2.

If it is visible from some point in front of the battery, two men (*A* and *B*, provided with pointing rods) can obtain the line as follows:—*A* lines *B*'s rod on the battery, *B* lines *A*'s rod on the object. They move about until the rods are correctly laid, and then plant them. The line thus obtained can then be projected to the rear by running a line of rods or banderols up to the battery.

If there is no spot either in rear or in front whence the object can be seen, some point on the flank must be found whence both the battery and the object are visible. The distance of this spot from the battery and object is measured (by range finder) and the included angle taken by pocket sextant.



The sides AC and CB and the included angle ACB of the triangle ABC are then known, and the remaining side BA (the required range) and remaining angles can be calculated.

The angle by the formula $\frac{a+b}{a-b} = \frac{\tan \frac{1}{2}(A+B)}{\tan \frac{1}{2}(A-B)}$
and the side by that of $c = \frac{a \sin C}{\sin A}$.

B (battery)

Having found the angle ABC , the sextant is set at this angle, and the officer using it places himself at the point B , which should be in rear of the gun. He sees the point C by direct vision, and has a picket or pointing rod moved along the parapet until its reflection cuts C . The rod is then in the line of fire BA .

The line of fire may also be obtained roughly from a good map or plan.

9. Laying the gun.

Having obtained the line of fire by any of the preceding methods, the gun may be laid by any one of the methods, described in §§ 3 to 7, found most convenient or applicable to the case in point.

In firing either guns or howitzers at elevations of 10° and upwards, it is important to ascertain if the trunnions are level. The difference of level should not be great if the platform has been properly laid, but after continued firing (especially from a howitzer on its bed at high angles of elevation, if the howitzer is not in the centre of the platform) even the best laid platform is liable to give slightly. If the difference of level exceeds 1° , the platform should be levelled at the first opportunity, or pieces of plank placed under the lower wheel—one inch of plank for each degree of difference of level. If the difference is within 1° it may be corrected by giving deflection on the scale on the higher side, according to the formula—

$$\text{minutes deflection} = \frac{n \times \theta^\circ}{60} \quad \begin{matrix} n = \text{the number of minutes difference of} \\ \text{level} \end{matrix} \\ \theta = \text{angle of elevation in degrees.}$$

The howitzers have cross planes cut on them for the quadrant. The guns have not; with them the level must be ascertained by applying the quadrant to the horizontal lines on the face of the muzzle, or on a straight rod placed across the top of the wheels—a drag-rope hooked into the washer of one of the wheels, passed over the top of the wheels, and stretched tightly, by the detachment hauling on it on the opposite side might be substituted for the rod in case of necessity).

10. Firing by night.

If the enemy's works are illuminated.

If this is done by means of the electric light the firing may be carried out as in the day time.

If by star shells, which only give a momentary illumination, the guns in the battery would be loaded, and the elevation and direction roughly given before the star shells are fired. As soon as the enemy becomes visible, the laying is completed and the gun fired.

The object of lighting up an enemy's works is to ascertain if he is repairing his batteries or throwing up new ones, and to guard against sorties, &c.

Night firing under normal conditions.

The only two methods available are the hanging scales and Captain French's. The line will have been obtained and corrected by daylight.

a. Hanging scales.

The gun is laid as described in § 3, but a lantern is required to light up the scales.

b. Captain French's.

A light is substituted for the rear mark. The gun is laid as described in § 6.

The simplest plan is to use for the rear mark a box or frame, inside which the lantern can be placed. The line is thus not disturbed.



The front of the box or frame should consist of a plate of ground glass, oiled linen or some other semi-transparent substance, of a light colour, with thick wires stretched diagonally across it, whose intersection is the point to lay on both by day and night.

PROJECTILES.

The common shell is the principal projectile of the siege artillery. When fired from guns the R.L. percussion fuze is nearly invariably used with it.

It may be employed for breaching or demolishing masonry, destroying buildings, earthworks, &c., dismounting the guns and injuring the personnel of the enemy.

If an earthen parapet has to be destroyed, it should be cut down gradually, commencing at the top. It has been found by experience that a shell exploding low down in a parapet will merely throw up a mass of earth, which frequently falls back again into its original position.

Dismounting fire against guns, carriages, &c., to be effective should be enfilade. A direct frontal fire is comparatively harmless. A gun seen directly from the front offers a very small mark, and it may be hit many times (unless struck on the muzzle or trunnions) without being dismounted or even seriously injured.

Shrapnel fire is of little value against troops behind earthworks, unless they can be enfiladed. It will generally be employed against the enemy's working parties, sorties, &c.

The time fuze should be bored so as to burst the shell from 50 to 100 yards short of the object fired at.

Case shot is used at ranges within 600 yards to repel sorties, &c. On good ground the gun may be laid point blank up to 200 yards range, and about $\frac{1}{2}$ ° elevation given for every additional 100 yards. On broken or boggy ground more elevation must be given.

OBSERVATION OF THE EFFECTS OF FIRE.

Good results cannot be expected unless the effect of each round is carefully watched and noted. If it is impossible, from the immediate neighbourhood of the battery or from the battery itself, to observe the impact and burst of the shells, an observing station should be established in front and not too much on the flanks of the battery, from which the result of each round or series of rounds can be communicated by signal to the officer commanding the battery.

If the fire is directed against guns, &c., behind earthworks, hits in the parapet can frequently be recognised, the smoke from the short bursts obscures the enemy's works, that from the bursts over forms a background on which the works will be more distinctly seen.

In breaching fire the sound of the bursts is sharp when the shells explode on masonry, smothered when they explode in earth. The debris from the wall is often thrown up to some height in the air by the explosion. Before the wall is penetrated the smoke will be observed almost immediately on the explosion, when it has been penetrated the smoke is longer in appearing, and the sound of the bursts is duller than before.

In making corrections in elevation it must be remembered that half the number of rounds fired may be expected to be short of and half beyond the mean point of impact (or mean range).

For instance, if the object is to dismount an enemy's guns, &c., by frontal fire, the mean point of impact should be as nearly as possible the interior crest

of his parapet. If, therefore, half the rounds are observed to strike the parapet or fall short, and the other half burst in rear of the parapet, we know that the elevation is correct. If in the course of the practice more than the proper proportion of rounds are observed to fall short or over, the elevation should be corrected accordingly.

The lateral deviation must be observed and corrected from the battery itself.

Use of Gun-cotton for the Destruction of Guns.

The Hasty Disabling of Siege Guns.

This duty will be performed by the Royal Artillery, the necessary supplies of gun-cotton and detonators being obtained from the Royal Engineer Field Park.

The following stores will be carried with each unit of the siege train :—

- *(a.) Two cartouches, each containing eight half slabs (1 lb. each) of dry gun-cotton.
- (b.) Two cylindrical leather cases, each containing a tin cylinder holding eight detonators (No. 8), with Bickford fuze attached.
- (c.) Two leather pouches, containing a flint and steel striking apparatus, and a small reel of twine.

The operation of disabling the captured guns will be performed by a party of the Royal Artillery (corresponding to a "spiking" party), who will be furnished with the necessary stores.

In the case of guns of 64-pr. calibre and upwards, place two half slabs of gun-cotton lengthwise on the chase, and their long sides touching about one foot from the muzzle tying them on with twine to secure them from disturbance by wind or other accidental cause. Insert a No. 8 detonator with a length of Bickford fuze attached, in the hole of one of the slabs. The tail of the Bickford fuze should point to leeward, to lessen the chance of a spark igniting the gun-cotton before the detonator acts.

It only now remains to light the Bickford fuze with the apparatus provided for the purpose, and to retire to a safe distance, about 50 yards, and await the result of the explosion. The 2-feet length of Bickford fuze burns about 40 to 50 seconds, giving ample time to the operator to retire to a position of safety.

Should a projectile proper to the gun be available, it is desired to see whether the bore has been so dented as to prevent loading; if it has not, the operation should be repeated, using two half-slabs tied on to the same spot, and in the same manner as before.

Should circumstances permit, the effect of the detonation may be increased by placing a filled sand-bag or a sod of turf on the gun-cotton when lashed in position on the chase. This should be done before inserting the detonator, which should not be withdrawn from the tin cylinder in which it is carried until everything is ready for its insertion and ignition.

Caution.—No force is ever to be used in inserting the detonator. Its effect will be secured by its insertion as far as it will go without the use of force.

In order to ensure detonation, it is desirable that the gun-cotton should be perfectly dry; therefore, if it is necessary to use it while heavy rain is falling, some ready envelope should be employed for wrapping the slab in.

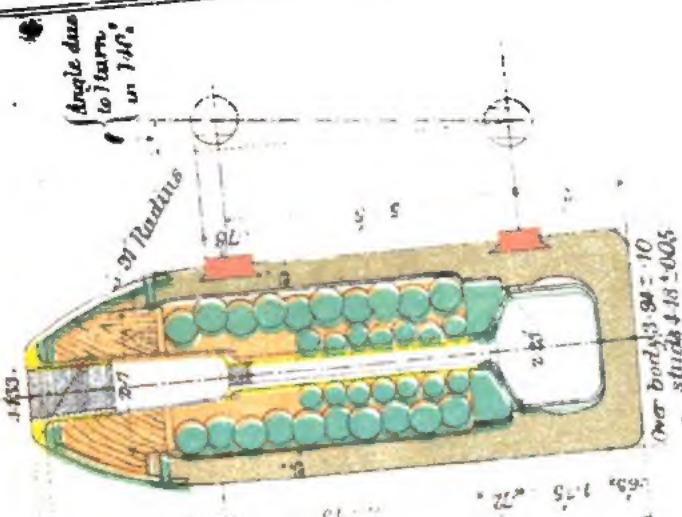
* The gun-cotton for this purpose will be obtained from the Royal Engineers.

COMMON SHELL 25 P. RIFLED M. L. PROJECTILES SHAPED SHELL

MARK II.

CASE SHOT

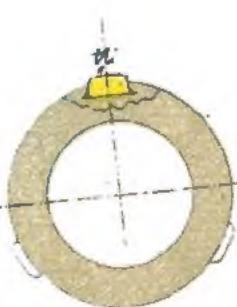
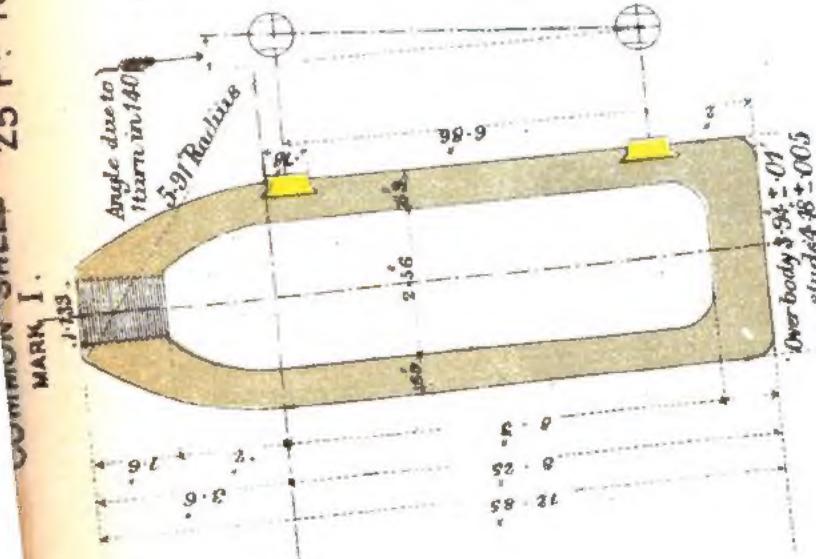
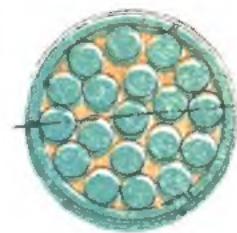
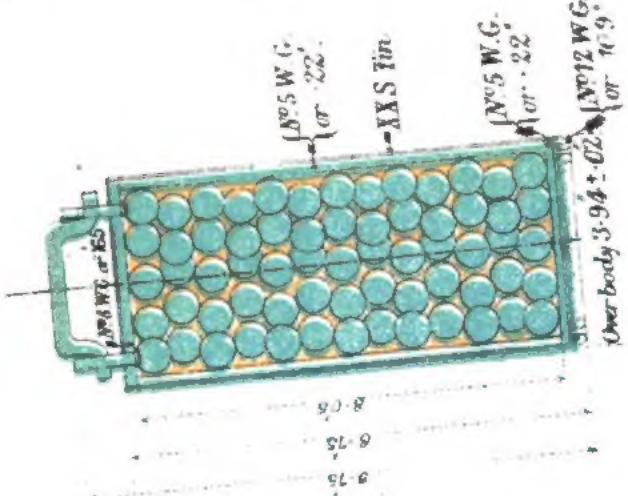
MARK I. 1.01.02.



Over body 3.94 ± .02 or .99

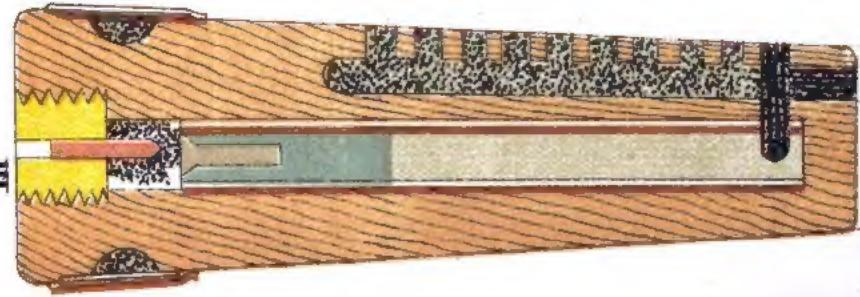
1.05 W.G.
or .22

XXX Tim

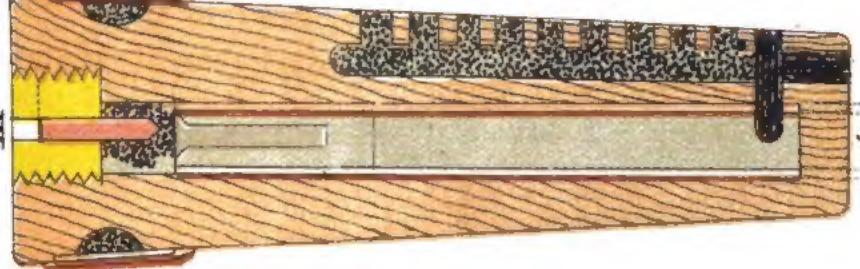


FUZES, TIME, WOOD BOXER. M. L. ORDNANCE.

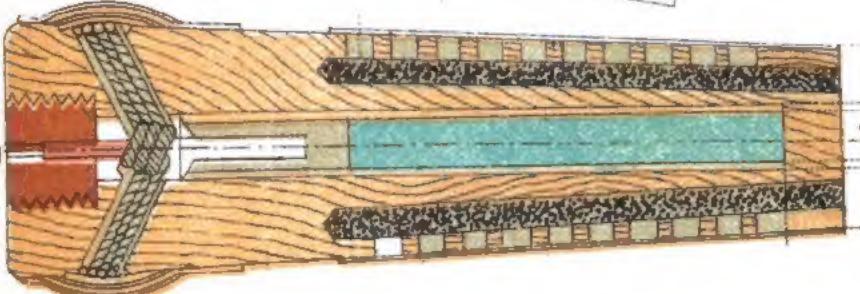
9 SECONDS. III



5 SECONDS. III



15 SECONDS. I



FUZE PERCUSSION R. L.

II

